**Small Business Innovation Research/Small Business Tech Transfer**

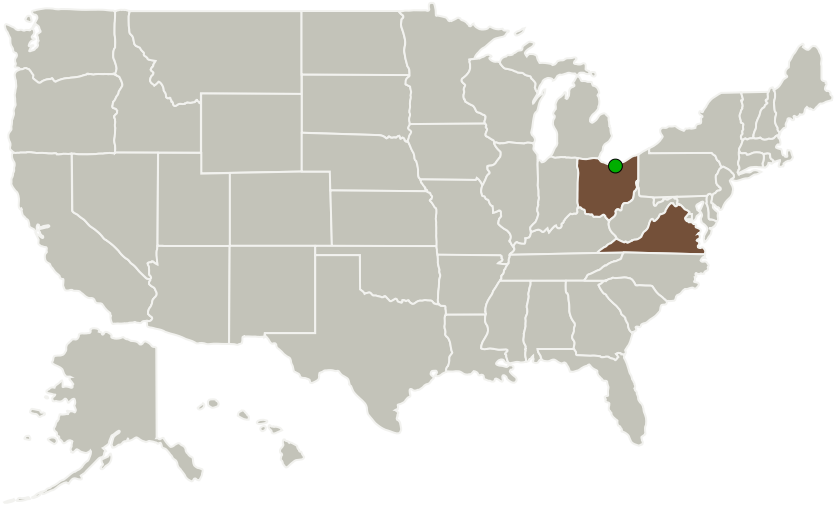
# 500C/3.8 kW-class Resonant-Mode Power Converter featuring SiC Super Junction Transistors, Phase I

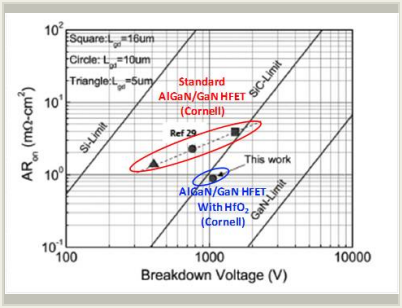
Completed Technology Project (2013 - 2013)

## Project Introduction

Capitalizing on a potent confluence of expertise in III-Nitride epitaxy, GaN-Si power device designs, and wide-bandgap power electronics, researchers at GeneSiC Semiconductor and Cornell University jointly propose a SBIR program focused on the development of 15 kW/300°C-rated power converters using AlGaN/GaN-Si MOS-HFETs and Schottky rectifiers. The proposed AlGaN/GaN-Si power converters to be developed in this program will usher in a new generation of high-efficiency, low-cost, and radiation-hard power conversion units on-board future NASA spacecraft. Phase I of this proposed work will focus on the optimization of the design and fabrication of the AlGaN/GaN-Si MOS-HFET and NSJ SBR devices. Phase II will be focused on the design and integration of Si/GaN gate-drive circuitry with the power SBRs and transistors to create high-power integrated circuits. Another major objective during Phase II will be the construction of Rad-Hard packaging for the power ICs. At the end of Phase II of this program, a fully-functional 15 kW/300°C rated power converter IC equipped with AlGaN/GaN-on-Si MOS-HFETs, Natural SuperJunction (NSJ) SBRs as free-wheeling diodes and on-chip SiC or III-Nitride gate drive circuitry will be demonstrated at a switching frequency of ≥ 1 MHz and at a temperature of ≥ 300°C. As compared to the existing state-of-the-art power electronics technology, the proposed AlGaN/GaN-on-Si power converters will offer (A) Lower on-state losses, 300°C operation and 1 MHz switching capability (B) A Lateral device architecture, which is highly desirable for construction for monolithic power integrated circuits (C) Possibility of hybrid interconnection of III-Nitride Power Devices with on-chip Rad-Hard AlGaN/GaN Gate Drive Circuitry (D) Desirable Normally-OFF Power Switches.

## Primary U.S. Work Locations and Key Partners



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| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| GeneSiC Semiconductor Inc. | Lead Organization | Industry<br>Minority-Owned Business, Small Disadvantaged Business (SDB) | Dulles, Virginia |
| Glenn Research Center(GRC) | Supporting Organization | NASA Center | Cleveland, Ohio |

| Primary U.S. Work Locations | |
|---|---|
| Ohio | Virginia |

## Project Transitions

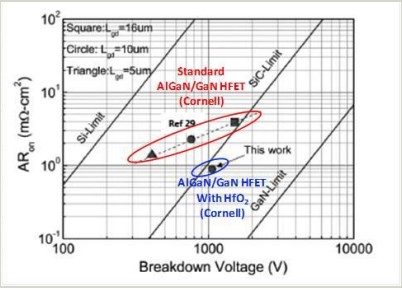
**May 2013:** Project Start

**November 2013:** Closed out

**Closeout Documentation:**

- Final Summary Chart*(https://techport.nasa.gov/file/140697)*

## Images




**Project Image**
500C/3.8 kW-class Resonant-Mode Power Converter featuring SiC Super Junction Transistors *(https://techport.nasa.gov/image/136493)*

## Organizational Responsibility

**Responsible Mission Directorate:**
Space Technology Mission Directorate (STMD)

**Lead Organization:**
GeneSiC Semiconductor Inc.

**Responsible Program:**
Small Business Innovation Research/Small Business Tech Transfer

## Project Management

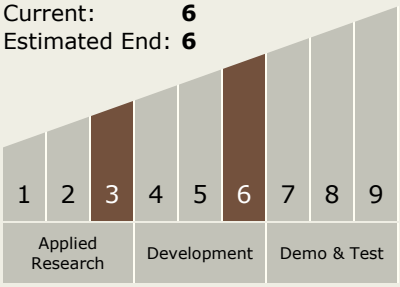
**Program Director:**
Jason L Kessler

**Program Manager:**
Carlos Torrez

**Principal Investigator:**
Siddarth Sundaresan

## Technology Maturity (TRL)

Start: **3**
Current: **6**
Estimated End: **6**



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## Technology Areas

**Primary:**

- TX01 Propulsion Systems
  - TX01.2 Electric Space Propulsion
    - TX01.2.2 Electrostatic

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System